PREY CAPTURE IN *TACHYDROMIA ANNULIPES* (MEIGEN) (DIPTERA: EMPIDIDAE)

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Enormous gaps exist in our knowledge of insect behaviour. For example there are nearly 400 species of predatory empids (Diptera, Empididae) in the British Isles yet prey capture and feeding behaviour of most species is little understood (Smith, 1978). Considerable scope therefore exists for making original observations, particularly on small species such as tachydromines (Smith, 1978).

Predatory behaviour is easy to observe, involving little more than offering live prey to empids in tubes. Prey capture was recorded in this way using a small tachydromine fly, *Tachydromia annulipes* (Meig.).

Tachydromines are small (0.7 to 5.5 mm long) and have modified legs (Collin, 1961; Chvala, 1975). Leg modifications vary but in *T. annulipes* they consist of the two anterior legs having enlarged femora and tibiae and with the mesothoracic legs having two latero-ventral rows of short black spines on the femora and a single mid-ventral row on the tibia. The tibial spines fit between those on the femora when the two parts of the leg are closed together (Lundbeck, 1912).

Tachydromines are reputedly rapacious (Lundbeck, 1912; Chvala, 1975). Lundbeck (1912) found remnants of insects between mesothoracic femora and tibiae and Chvala (1975) states that they hold prey with their middle legs.

Methods and results

From 25.v.1988 to 12.vi.1988 both sexes of *T. annulipes* were present on the leaves of a two-metre *Fagus sylvaticus* L. hedge at Newbattle Abbey, Midlothian, Scotland (NT 6532). Field observations were made on about 30 flies for an approximate total of 4 h during the study period.

T. annulipes adults ran rapidly over the foliage interspersed with short flights to adjacent leaves and periods of immobility. Their mode of running was very distinctive with the femora of the mesothoracic legs held straight out from the sides of the thorax.

Actual prey capture was not observed in the field although apparent searching movements were frequent. These involved orientation and slow approach towards similar sized, stationary or slow-moving flies ending with a run or jump at the potential prey. Occasionally, *T. annulipes* adults would twist their heads and lift the anterior part of the body up and down in apparent attempts to fix the position of potential prey before approaching it.

To observe prey capture in detail, adult *T. annulipes* were pooted individually into empty, 75 × 25 mm corked, glass tubes and, to standardize hunger levels, were left for 12–15 h in an outdoor insectory. After this period, live test prey, consisting of adults of *Phytomyza ranunculi* (Schrank) (Agromyzidae), which were found on the *F. sylvaticus* hedge, were added one to each tube. Tubes were observed continuously until prey were discarded.

Prey capture was observed 17 times in 11 flies and was, in each case, similar suggesting an underlying pattern of behaviour. To capture prey *T. annulipes* ran rapidly towards or jumped on the prey and grabbed its wings or legs with the mesothoracic legs. The struggling fly was very rapidly (< 5 sec) manipulated until its wing bases were held between the femora and tibiae of the mesothoracic

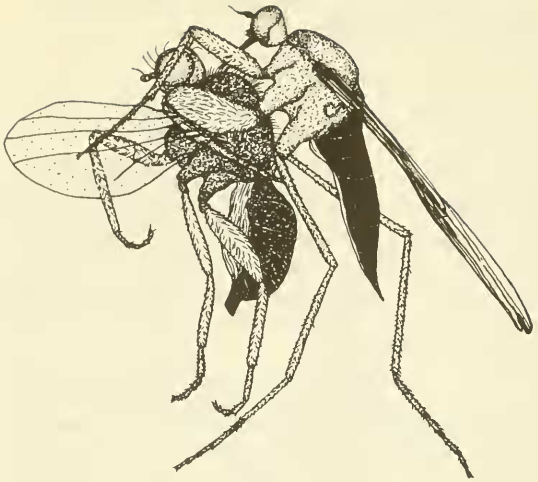

Fig. 1. *Tachydromia annulipes* attacking *Phytomyza ranunculi*.

legs with the dorsum of the prey turned towards the empid with the head of the prey uppermost. The predator spread its metathoracic legs and with the tip of the abdomen of the prey, three points of contact were formed with the substrate. This upright stance was the typical position in which initial feeding took place (Fig. 1).

The prey was pulled towards the mouthparts of the predator using the prothoracic legs which, when necessary, also warded off the still active legs of the prey. Using the prothoracic legs the predator pushed the head of the prey forward to expose the anterior part of the thorax into which it inserted its mouthparts. The prey ceased to move once the mouthparts of the predator were inserted but whether a venom is injected was not determined.

Average feeding time was 17.3 ± 4.8 min (n=8). When it ended the prey was turned upside-down and the predator inserted its mouthparts into the base of the abdomen and fed for a further 3.4 ± 2.8 min (n=5) before finally discarding the prey. If the predator was disturbed by approaching it with a brush or pin, feeding stopped and the predator moved away with the prey held between the tibia and femora of one of the mesothoracic legs.

To see whether prey capture was elicited only by active flies, prey were experimentally removed with a paintbrush (n=5) from a feeding predator and left in the tube. They were ignored although the predators readily attacked fresh, live *P. ranunculi* when added. In another series of experiments, live prey were killed by placing them in a freezer. They were then warmed to room temperature and individually introduced into tubes each containing a 12 h starved predator (n=6). These prey flies were similarly ignored.

In a separate investigation, nine 12 h starved predators were exposed individually to non-dipterous insects to see if they would be attacked. The insects were *Drepanosiphum platanoides* (Shrank), the sycamore aphid, *Psylla mali* (Schmidberger), the apple psyllid and an unidentified collembolan. Three replicates were made for each species of potential prey. None were attacked after 2 h exposure. These same predators, however, readily attacked unidentified flies about the size of *P. ranunculi* belonging to the families Lonchopteridae and Chloropidae at the end of the 2 h period.

Finally, using nine 12 h starved predators, larger (> 5 mm long) unidentified flies belonging to the families Muscidae and Calliphoridae and one identified syrphid, *Melanostoma scalare* (F.), were exposed to the predators. Again three replicates were made for each species of potential prey using different predators each time. None of these insects were attacked after 2 h.

Discussion

Some empids recognize prey using visual cues (Smith, 1978). The behaviour of *T. annulipes* in the field with its head twisting and movements towards other insects suggests that this species also relies on visual cues. That vision is important may also explain why only active prey were attacked: prey movement may provide essential visual cues eliciting an attack.

Poulton (1913) suggests that tachydromines feed mostly on Diptera. The observations made here support this suggestion: none of the non-dipterous insects presented to hungry adult *T. annulipes* were accepted but adults from three families of Diptera (Agromyzidae, Chloropidae and Lonchopteridae) were attacked. Furthermore, it appears that only flies of a similar size to *T. annulipes* elicit an attack. This could be due to the superior ability of large flies to defend against *T. annulipes*. However, no hungry *T. annulipes* attempted to attack large flies which would have provided a test of this possibility.

T. annulipes first manipulates the prey until the mouthparts have access to the front of the thorax. Apart from being a source of high-quality food, feeding on the thorax may have the added advantage of immobilizing the prey as the contents of the thorax are eaten. Discarded prey had empty thoraces.

T. annulipes caught and physically overcame prey using its legs. Each pair of legs has a separate role to play. The prothoracic legs are the shortest (length of prothoracic legs 2.86 mm; mesothoracic 3.80 mm; metathoracic 4.24 mm) and the femora are enlarged although they lack spines (maximum width of prothoracic femora 0.2 mm; metathoracic 0.3 mm; metathoracic 0.1 mm). The prothoracic legs manipulate prey into various positions during capture and feeding. The mesothoracic legs are greatly enlarged and possess rows of spines. They perform the important task of holding prey in a tight grip. The metathoracic legs are long, thin and lack spines. In its characteristic upright feeding position, they help to balance the fly and prevent it from falling over.

Given the specialized prey-handling technique of *T. annulipes*, it is highly probable that tachydromines with other types of leg modification use different methods. A comparative study of prey handling techniques is clearly indicated.

Acknowledgements

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